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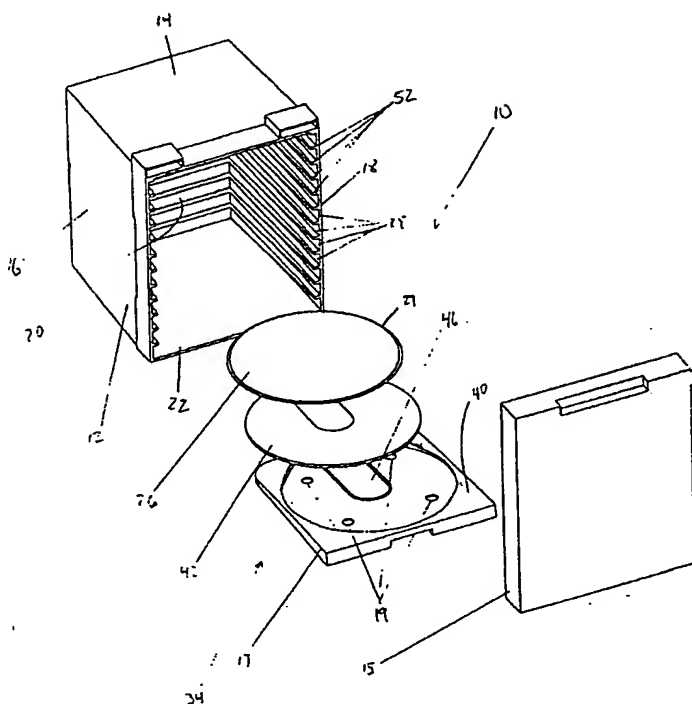
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[Continued on next page]

(54) Title: WAFER CONTAINER



(57) Abstract: A wafer container (10) for storing and transporting wafers (26) and the like, while protecting the wafers (26) from damage due to causes, including but not limited to, vibration or impact during shipping, contamination of the wafer surface, or static electricity. The container (10) includes a housing (12) with a top wall (14), bottom wall (22), sidewalls (16) and (18), and a back wall (20). The container (10) further includes a door (15) that preferably opens the entire front side of the housing (12). The sidewalls (16) and (18) preferably include a plurality of matching parallel grooves (28) spaced apart in a regular pitch. A plurality of cassettes (34), with dimensions selected to fit within the housing (12), are provided for holding the wafers (26). The cassette (34) preferably includes an upper surface (40), with a circular recess (38) formed therein to receive the wafer (26). An underlayer (42) formed of a resilient shock absorbing material is preferably formed within

the circular recess (38). In use the wafer (26) is placed directly on the underlayer (42) of the cassette (34). The cassette (34) is then slid into a pair of matching grooves (28) in the housing (12).

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*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

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## WAFER CONTAINER

## TECHNICAL FIELD

10           This invention relates generally to a container for storing and transporting at least one thin flat object including a variety of kinds of masks, display panels, hard disks, silicon wafers and the like, and more particularly for the storage and transport of at least one semiconductor wafer.

## 15   BACKGROUND ART

          Various prior art containers have been used in the electronics industry to protect and transport masks, displays, disks, and wafers. The high value and fragile nature of such items requires a very reliable means for supporting them  
20   within the container. Many containers are configured specifically for the storage of semiconductor wafers because they are particularly valuable and fragile.

          Semiconductor wafers are generally circular in shape and very thin. During the wafer manufacturing process, it is often necessary or desirable to  
25   move partially completed wafers from a first manufacturing facility to a second manufacturing facility for completion. This requires that the wafers be removed from the first manufacturing assembly, then packed and shipped to the second facility, where they are unloaded for further processing, without causing any

5 damage to the wafer. Sources of damage include, but are not limited to, vibration, scraping, or impact during shipping, contamination of the wafer surface, or the destruction of printed circuitry by static electricity.

In the past, the handling of wafers by the edges has been preferred in  
10 order to prevent damage to, or contamination of, the surface of the wafer. Consequently, known semiconductor wafer carriers have generally stored wafers in stacked holders supporting the wafers only at the edges.

A continuing trend in the electronics industry is the ever-increasing size,  
15 and decreasing thickness, of the wafers that must be stored and shipped. As the size and corresponding surface area of the disks increases, and as the thickness of the wafers decreases, new techniques must be found to protect them from damage. The use of rigid supports on the edges of the wafers (prevalent in prior containers) is not sufficiently effective in protecting these larger more delicate  
20 wafers. Furthermore, many prior shipping containers have not been well adapted for handling by robotic or automated machinery, thus requiring manual intervention at various stages for loading and unloading. In the processing of semiconductor wafers, there is an inverse relationship between chip yield and particle contamination. Every step requiring manual handling of the wafers  
25 increases contamination problems. Concern for particle contamination has increased as chip circuit geometries have decreased, because of the increased potential for contamination by ever smaller particles.

5           What is needed is a wafer container that adequately supports the larger and thinner wafers to avoid damage to the wafer, that protects the wafers.

#### SUMMARY OF THE INVENTION

10           Accordingly, the present invention is a shipping and storage container for storing and transporting a plurality of disc shaped objects, such as wafers and the like, while preferably protecting the items from vibration, abrasion, impact, particulation, static electricity, and outgassing. Although the embodiments described in this application are configured for holding wafers,  
15           the invention could be easily modified by one of ordinary skill for storing other materials including, hard disks, photomasks, liquid crystal displays, flat panel displays, and the like.

          In its broadest sense, the wafer container of the invention comprises at  
20           least one cassette that may further be inserted into a housing. The cassette is designed to support a substantial portion of the bottom surface of the item, such as a wafer. The cassette is preferably dimensioned to fit within the housing. The cassette preferably includes a tray with an upper surface with a circular recess formed therein to receive the wafer. An underlayment formed of a  
25           resilient shock absorbing material is preferably formed within the circular recess. The cassette preferably includes a cutout extending from the bottom surface of the tray to the top surface of the tray, including through the underlayment, to allow access to the bottom surface of the wafer. The tray may

5 further include through holes to allow pins to pass through the holes to contact the bottom surface of the wafer to lift the wafer from the cassette. This allows some kinds of commonly used robotic arms to access the wafer.

In some embodiments of the tray, the side edges of the tray include a  
10 plurality of spring structures, which may provide a number of benefits, including but not limited to, acting as shock absorbers, allowing the parts of the wafer carrier to be manufactured with larger tolerances which may reduce the cost of manufacture. The springs can also be used to compensate for any required draft angle resulting from manufacturing requirements related to the  
15 injection molding process.

In further embodiments, the cassette may include latching features of a variety of known kinds for holding the wafer onto the cassette. The cassette may also include features for use in the manual or robotic manipulation of the  
20 cassette, and may also include means for identifying the contents of the cassette including typed or written labels, bar codes, transponders, magnetic strips, microterminals, or the like.

The housing may be configured in several ways depending on how  
25 many cassettes the housing is designed to carry. In one embodiment, the housing is configured for carrying a plurality of cassettes and includes sides defining a storage chamber, to receive the cassettes, with at least one side of the

5 housing including grooves formed thereon to receive an outer edge of the cassettes.

More particularly, the container includes a housing with top and bottom walls, two sidewalls, and a back wall. The carrier further includes a door that  
10 preferably opens the entire front of the housing. The sidewalls preferably include a plurality of matching parallel grooves spaced apart at a regular pitch. The external surfaces of the housing may include a number of known features, such as handles, selected to assist in the manual or robotic manipulation of the housing.

15

In a second embodiment of the housing, the housing is configured to carry a single cassette. In this configuration the housing preferably includes a bottom portion for holding the cassette, and a top portion that fits on or over the bottom portion to enclose the cassette. The top portion may include features  
20 that extend from the underside of the top portion of the housing to contact either the cassette or the wafer or both to assist holding the cassette or wafer in place.

In use the wafer is placed directly on the underlayment on the tray. The cassette is then slid into a pair of matching grooves in the housing. In one  
25 embodiment the ridges between the grooves extend over a small portion of the top surface of the wafer near the outer perimeter, or edge of the wafer. This prevents the wafers from lifting off of the underlayment.

5 BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded perspective view of a first embodiment of the invention comprising a housing for carrying a plurality of  
10 cassettes.

FIG. 2 is a top view of one embodiment of the cassette of the invention.

15 FIG. 3 is a bottom view of the cassette of FIG. 2.

FIG. 4 is cross section of the cassette of FIG. 2 taken along lines 4-4.

FIG. 5 is cutaway side view of an edge of the loading tray of FIG. 2,  
20 taken along line 4-4, positioned within a groove in a side wall of the housing, showing the ridge above the wafer extending slightly over the upper surface of the wafer.

FIG. 6 is a top view of an embodiment of the loading tray including  
25 integrally formed half loop springs.

FIG. 7 is a cutaway side view of an edge of a loading tray including half loop springs positioned within a groove in the side wall of



5                   the housing, showing the ridge above the wafer extending slightly over the upper surface of the wafer.

FIGS. 8a,b,c, and d show several embodiments of latching mechanisms for holding the wafer on the underlayment of the cassette.

10                   FIG. 9 is an exploded perspective view of a second embodiment of the invention comprising a housing for carrying a single cassette.

15

## DETAILED DESCRIPTION OF THE INVENTION

The present invention provides a container for carrying items such as any of a variety of kinds of semiconductor wafers, hard disks, photomasks, liquid crystal displays, flat panel displays, or other items. The container of the invention departs from the majority of the prior designs by supporting the wafer on the underside of the wafer by contacting a substantial portion of a bottom surface of the wafer. Prior containers typically make great effort not to touch or support the wafer anywhere except at the edges of the wafers.

20

25

A detailed description of several exemplary embodiments of the invention will now be made with reference to the figures 1 through 9, wherein

5 like features are identified by like numbers. Although the embodiments described herein are configured for holding wafers, the invention could be easily modified by one of ordinary skill for storing other materials including, hard disks, photomasks, liquid crystal displays, flat panel displays, or other items could also be shipped using this system.

10

The wafers are generally made of silicon, but may also be fabricated from or comprise other materials such as gallium arsenide. The wafers are generally processed to form integrated circuit devices on at least one side thereof. This adds substantial value to the wafer, therefore it is extremely  
15 important that the wafers are protected from damage.

Referring to FIG. 1, a preferred embodiment of the wafer shipping and storage container of the invention (hereafter "container 10") is shown. A key element of the invention is the use of one or more loading trays 34 that each  
20 support a single wafer 26 by contacting a substantial portion of a bottom surface of the wafer 26.

FIG. 2 shows a top view of the cassette 34, which preferably includes a tray 17 with a cylindrical recess 38 formed in the top surface 40 of the tray 17.  
25 In some embodiments the wafer may be received directly into the recess 38, however, in the preferred embodiment, an underlying material, hereafter underlayment 42, is preferably formed within the cylindrical recess 38 for providing a resilient cushion to support the wafer 26. FIG. 4 shows a cross

5 section of the loading tray of FIG. 2 taken along lines 4-4. The underlayment 42 preferably includes a peripheral bevel 44 around the entire periphery of the underlayment 42 to allow a wafer 26 placed on the underlayment 42 to self center as it drops in place. The underlayment 42 is preferably formed of a synthetic low particulating rubber with a durometer between 13 and 18,  
10 however, other known materials may be acceptable. In some embodiments, features may be formed in the cylindrical recess 38 to assist the underlayment 42 in gripping or adhering to the tray 17 of the cassette 34.

In some preferred embodiments, the cassette 34 also includes a cutout  
15 46, as seen in FIGS. 2 and 3, that extends from the bottom surface 48 of the cassette 34 to the top surface 40 of the cassette 34, including through the underlayment 42, and from one edge of the cassette 34 to some selected distance inward towards the center of the cassette 34. FIG. 3 shows a bottom view of the cassette 34 showing a particular configuration of the cutout 46, and  
20 illustrates that a portion of the underside of the wafer 26 is accessible through the cutout 46. In alternate embodiments, the cutout 46 can be any desired size and shape, but should be at least sufficiently large to allow manipulation of the wafer 26 by known robotic wafer 26 handling means. The size and or shape of the cutout 46 can be varied depending on the shape of the robotic arm that is  
25 intended to be used to access the wafer 26 stored thereon. It is preferable that the cutout 46 be positioned on the cassette 34 so that the cutout 46 is open at the front edge 36 of the cassette 34 because this is typically the most convenient position for a robotic arm to reach. However, in alternate embodiments, the

5 cutout 46 could be positioned at other locations on the cassette 34. The cutout 46 allows a robotic arm to engage the bottom surface of the wafer 26, preferably with a vacuum grip, for removal or loading of the wafer 26 without the need to touch the top surface of the wafer 26. In further alternate embodiments, the cassette 34 may not include any cutout.

10

In some embodiments, it is preferred to include a number of through holes 19 that extend from the bottom surface 48 of the cassette 34 to the top surface 40 of the cassette 34, including through the underlayment 42. The through holes 19 may be used to allow pins to extend from below the cassette 15 34 to contact the bottom surface of the wafer 26 and lift the wafer 26 from the cassette 34. This makes the wafer 26 accessible to certain kinds of known and commonly used robotic arms for unloading of the cassette 34.

Some preferred embodiments of the cassette 34 may include several 20 wafer latches that contact the upper surface of the edge 27 of the wafer 26 to hold the wafer 26 against the underlayment 42. Referring to FIGS. 8a through 8d, several examples of latches that may be useable are shown. However, many other kinds of known latching systems may be useable, and the invention is not limited to those latches shown or discussed below.

25

FIG. 8a shows an example of a latching mechanism including a slot 70 with a slideable latch 72 in the open position. When the slideable latch 72 is moved to the other end of the slot 70, as seen in FIG. 8b, a portion of the latch

5 overlaps the edge 27 of the wafer 26, preventing the wafer from moving upward  
off of the cassette 34. FIG. 8c shows another example of a latch mechanism  
including two apertures 74 configured to accept extensions on the underside of a  
snap latch 76. In this embodiment, the extensions on the snap latch 76 are  
pressed through the apertures 74, as seen in FIG. 8d, so that a portion of the  
10 latch overlaps the edge 27 of the wafer 26, preventing the wafer from moving  
upward off of the cassette 34.

In some embodiments of the cassette 34, the side edges of the cassette  
34 may include a plurality of spring structures. FIG. 6 shows an embodiment  
15 including half loop spring structures 50, however, in alternate embodiments  
other known spring structures could be used, and the relative size of the spring  
structures could also be easily varied. The spring structures 50 are preferably  
fabricated integrally with the cassette 34, however in alternate embodiments  
they may be coupled to the edges of the cassette 34 by any practical means in a  
20 separate manufacturing step. The springs 50 provide several benefits including  
acting as shock absorbers, allowing the parts of the wafer 26 and housing 12 to  
be manufactured with larger tolerances, which may reduce the cost of  
manufacture. The springs 50 can also be used to compensate for any required  
draft angle resulting from manufacturing requirements related to the injection  
25 molding process typically used to fabricate such parts.

In some embodiments the upper surface 40 of the tray of the cassette 34  
may include locations configured to display identifying information describing

5 the contents of the cassette 34, for example typed or written labels, bar codes, transponders, magnetic strips, or microterminals may be affixed thereon.

Referring again to FIG. 1, one embodiment of the invention comprises a housing 12 configured to hold a plurality of cassettes 34. In this embodiment  
10 the housing 12 includes an interior storage space defined by the interior surfaces of the top wall 14, the side walls 16 and 18, the back wall 20, and the bottom wall 22. The housing 12 further includes a door that preferably opens the side of the housing 12 opposite the back wall 20.

15 The housing 12 is shown as a simple cube in FIG. 1, but any practical shape could be used. In fact, the exterior shape of the container 10 is not critical to the invention. Furthermore, there may be additional features on the exterior of the container 10 to assist in the handling of the container 10. For example, one or more handles for carrying the container 10 may be formed on or attached  
20 to the outer surface of any of the walls of the container 10. Furthermore, the outer surfaces of the container 10 may include features intended to assist robotic manipulation of the container 10.

It is preferred that one entire side of the housing 12 open so that the  
25 wafers 26 stored therein can be selectively accessed. Thus, in the embodiment seen in FIG. 1, the door 15 preferably may be detached from the housing 12. However, In alternate embodiments, virtually any method of providing an opening to access the wafers 26 stored in the container 10 may be used, and the

5 actual opening or door 15 configuration selected is not critical to the invention. For example, in alternate embodiments, the door 15 may slide up or to one side, or may open on a hinge. The door 15 preferably includes a latching means for locking the door 15 in a closed position. Many types of useable latches and locks are well known, and virtually any known and acceptable latch could be  
10 readily used by those skilled in the art to prevent the door from door 15 inadvertently opening. The latch means selected preferably also includes some means for indicating whether the wafer container 10 has been tampered with, and many such tamper indicators are well known in the art.

15 The wafer shipping container 10 is preferably molded from polycarbonate or polypropylene, however, any desired material may be used, although, the material selected will preferably be characterized by high strength, low weight, low particulation, and resistance to the buildup of static charge.

20 The sidewalls 16 and 18 of the housing 12 include matching grooves formed in the opposing interior surfaces of the side walls 16 and 18. The grooves 28 allow a cassette 34 to be inserted into the housing 12 between each set of opposing grooves 28. The cassette 34 is inserted until the rear edge of the cassette 34 contacts the back wall 20 of the housing 12. In some embodiments,  
25 it may be desirable for the back wall 20 of the housing 12 to include a groove that runs between the grooves 28 of the side walls 16 and 18 and into which the rear edge of the cassette 34 is accepted, as seen in FIG. 1. In the preferred embodiment seen in FIG. 1, the grooves 28 are wider at the front than at the

5 back of the housing 12. Thus, a wedge shaped loading trays 34 would be used. However, in other preferred embodiments, the sides of the grooves 28 on opposite walls run in a plane parallel to the plane of the bottom wall 22 of the container 10. In other alternate embodiments, the grooves 28 may be aligned or configured differently than the examples given above.

10

The cassettes 34 are preferably rectangular in shape and sized to fit in the housing 12 between a pair of opposing grooves 28. In alternate embodiments in which the housing defines a differently shaped interior, the shape of the cassette 34 may be modified to conform to the alternative shape of  
15 the interior of the housing. For example, if the housing defined a triangular interior, the cassettes used therein may be triangular in shape; if the interior was cylindrical, the cassettes may be round.

FIG. 5 shows a cutaway side view of an edge of the cassette 34 of FIG. 2, taken along line 4-4, positioned within a groove 28 in a side of the housing 12, showing the ridge 52 above the wafer 26 extending slightly over the edge 27 of the upper surface of the wafer 26. If the container 10 is turned upside down, the overlapping ridge 52 will contact the upper surface of the wafer 26 and prevent the wafer 26 from falling away from protective underlayment 42. In the  
25 embodiment including grooves 28 cut into the back wall 20, the ridges from the back wall 20 may provide a third overlapping contact point.. In embodiments using wafer latches 54, the ridges 52 need not overlap the edge of the wafer 28,



5 as the latches 54 perform the function of preventing the wafer 28 from leaving  
the cassette 3

FIG. 7 shows a similar view to that of FIG. 5, but is a cutaway of the  
tray of FIG. 6 taken along line 7-7, showing an embodiment including the  
10 springs 50 formed on the edge of the cassette 34, and resting within the groove  
28

In a second preferred embodiment of the housing of the wafer carrier 10 of  
the invention, the housing is configured to carry a single cassette 34. Referring  
15 to FIG. 9, an embodiment of the single tray housing is shown with a bottom  
portion 62 configured to accept the cassette 34, and a top portion or lid 64  
configured to couple to the bottom portion 62. The top portion 64 may include  
features that extend from the underside of the top portion 64 of the housing to  
contact either the cassette 34 or the wafer 26 or both to assist holding the  
20 cassette 34 or wafer 26 in place.

To those skilled in the art, many changes and modifications will be  
readily apparent from the consideration of the foregoing description of a  
preferred embodiment without departure from the spirit of the present invention.  
25 The description herein and the disclosures hereof are by way of illustration only  
and should not be construed as limiting the scope of the present invention.

## Claims

Would be claimed is:

- 1 1. A container for holding a wafer, the container comprising:  
2  
3 a cassette comprising a tray having a top, a bottom, and a plurality of sides, and  
4 including a depression configured to accept the wafer formed on the top of the tray,  
5  
6 whereby the wafer is supported on the base by substantial contact with the bottom  
7 surface of the wafer.
- 1 2. The container of claim 1, further comprising an underlayer formed in the  
2 depression on the top of the tray.
- 1 3. The container of claim 2, wherein the underlayer defines a depression sized  
2 to accept a wafer.
- 1 4. The container of claim 3, wherein the underlayer further comprises a beveled  
2 edge.
- 1 5. The container of claim 1, wherein a cutout is formed in the cassette extending  
2 from the bottom of the tray to the top of the tray, and extending from a side of the tray  
3 toward a center of the tray.

1 6. The container of claim 1, further comprising holes extending from the bottom of  
2 the tray to the top of the tray.

1 7. The container of claim 1, wherein the cassette further comprises a latch coupled  
2 to the tray for holding the wafer onto the tray.

1 8. The container of claim 1, further comprising a housing for holding at least one  
2 cassette.

1 9. The container of claim 8, wherein the housing is configured to hold a plurality  
2 of cassettes.

1 10. The container of claim 9, wherein the housing comprises a top wall, a bottom  
2 wall, opposing sidewalls, a back wall, and a door.

1 11. a container for holding at least one disk shaped object, the container  
2 comprising:

3

4 a cassette including a tray having a top, a bottom, and a plurality of sides, and  
5 including a depression configured to accept the wafer formed on the top of the tray, and  
6 including a depression formed on the top side of the tray configured to accept the disks  
7 shaped object,

8

9 a housing for holding at least one cassette,

10

11 whereby the wafer is supported on the tray by substantial contact with the bottom  
12 surface of the wafer, and the cassette is held in the housing.

1 12. The container of claim 11, further comprising and underlayment formed in the  
2 depression on the top of the tray.

1 13. The container of claim 12, wherein the underlayment defines a depression  
2 configured to accept a wafer.

1 14. The container of claim 13, wherein the underlayment further comprises a  
2 beveled edge.

1 15. The container of claim 12, wherein a cutout is formed in the cassette extending  
2 from the bottom of the tray to the top of the tray, and through the underlayment; and  
3 extending from a side of the tray toward a center of the tray.

1 16. The container of claim 12, further comprising holes extending from the bottom  
2 of the tray to the top of the tray, and through the underlayment.

1 17. The container of claim 11, wherein the cassette further comprises a latch  
2 coupled to the tray for holding the wafer onto the tray.

1 18. The container of claim 11, further comprising a housing for holding at least one  
2 cassette.

1 19. The container of claim 18, wherein the housing is configured to hold a plurality  
2 of cassettes.

1 20. The container of claim 19, wherein the housing comprises a top wall, a bottom  
2 wall, opposing sidewalls, a back wall, and a door.

1 21. The container of claim 20 wherein the opposing sidewalls comprise a plurality  
2 of grooves to accepting an edge of a cassette.

1 22. The container of claim 21 wherein adjacent grooves define a ridge  
2 therebetween, and wherein a height of the ridge is sufficient to overlap a portion of an  
3 upper surface of a wafer positioned in the depression on the top surface of the tray  
4 when a side of the tray is slid in a groove.

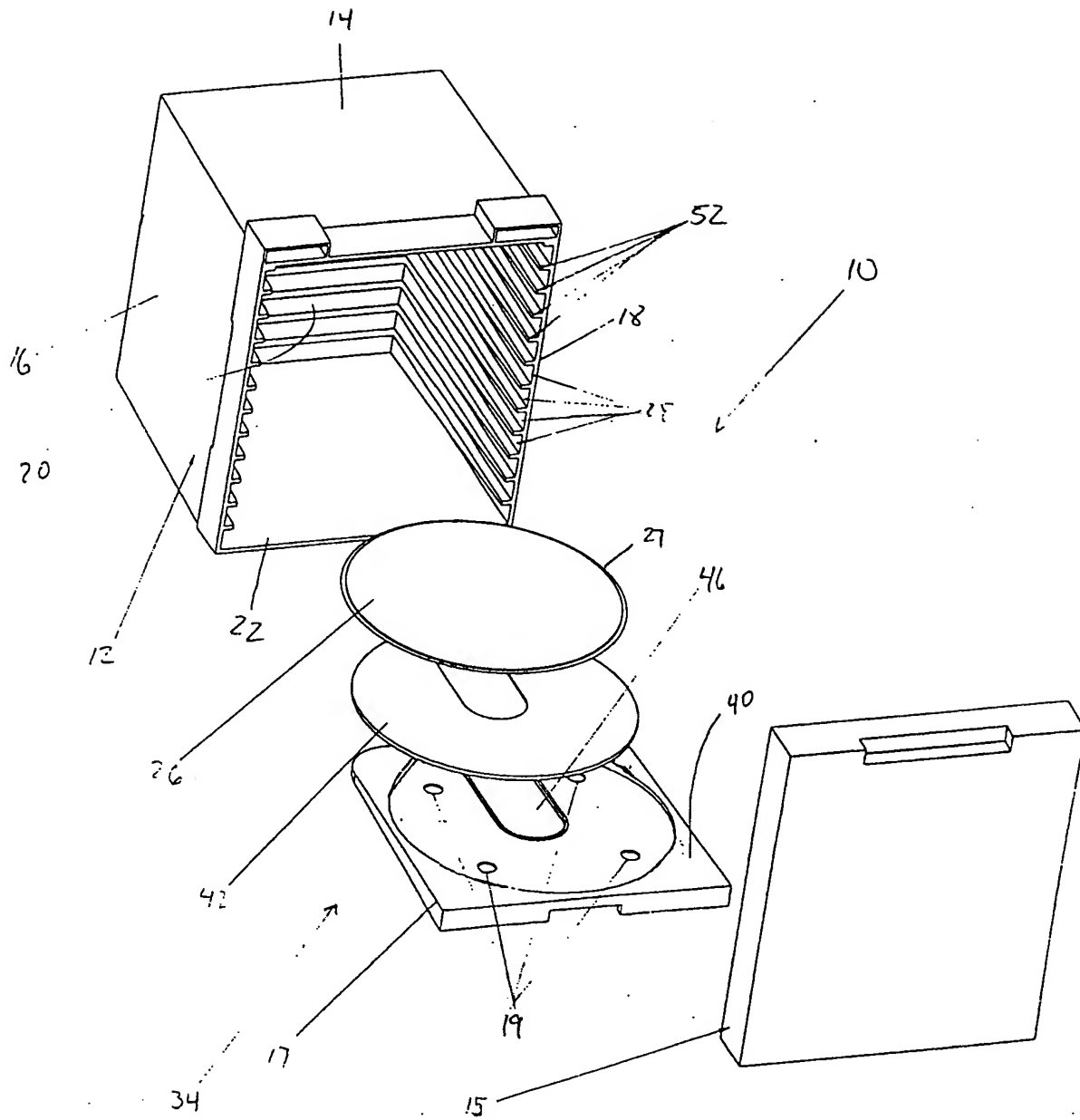
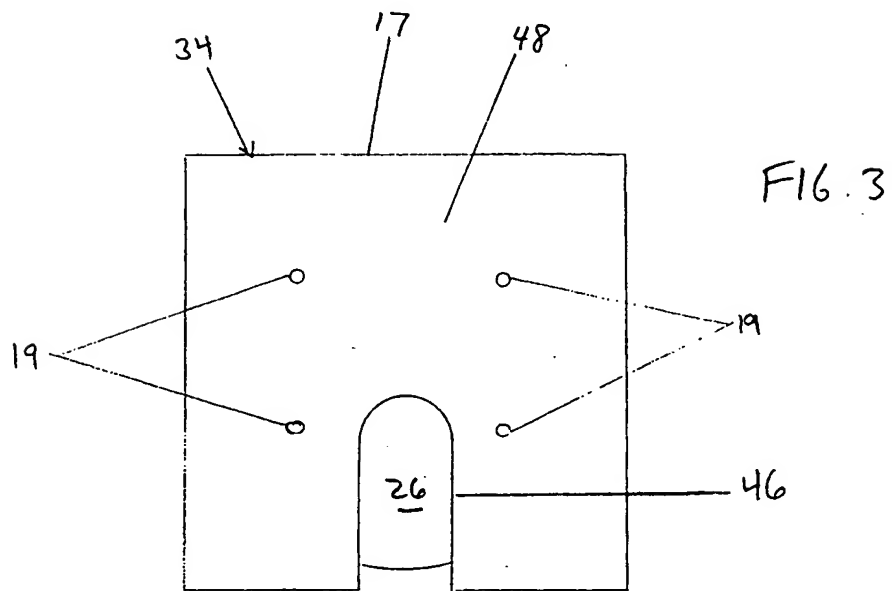
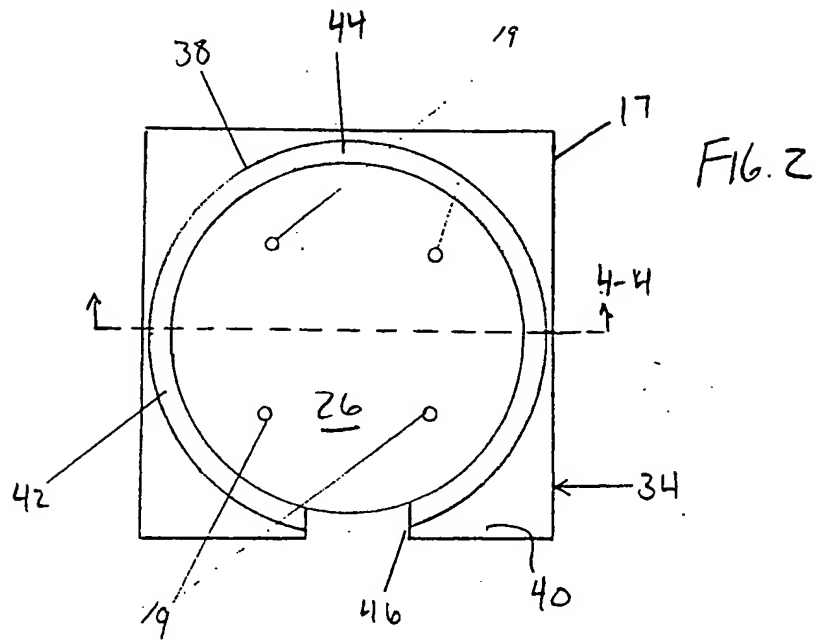


FIG. 1

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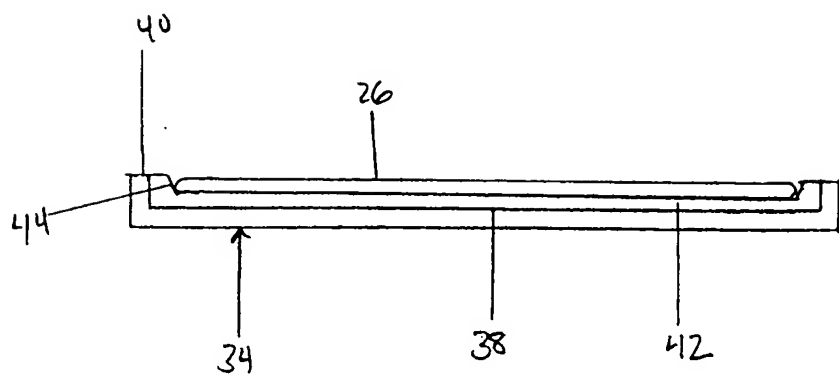


FIG. 4

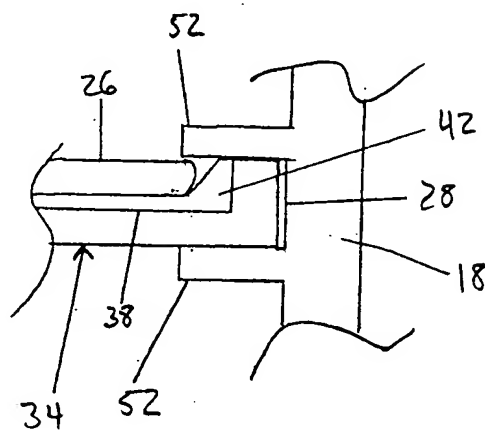
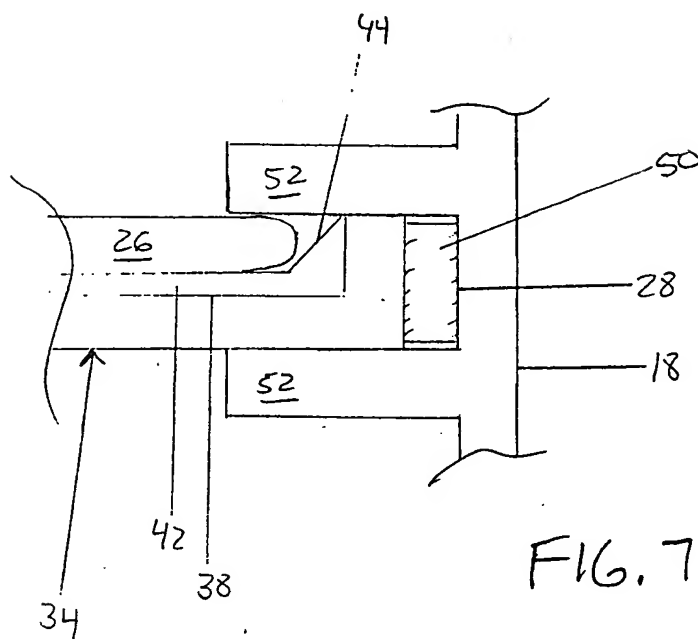
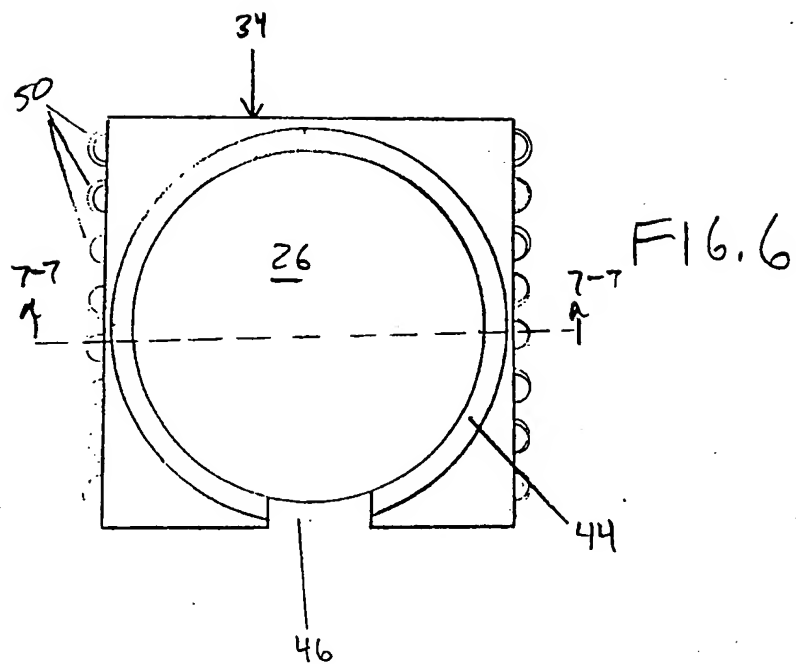
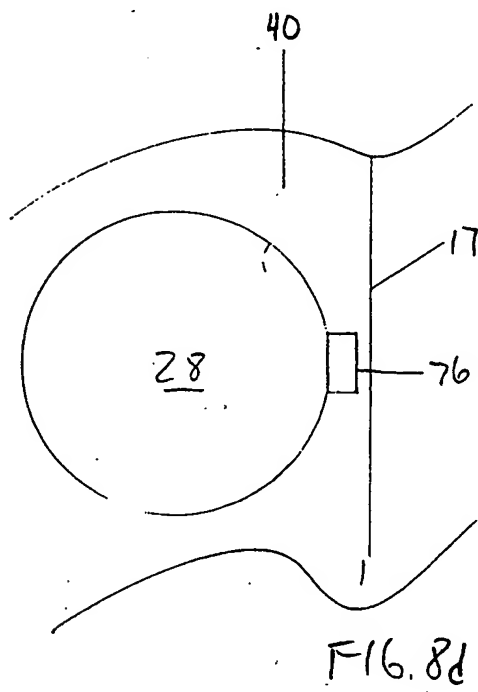
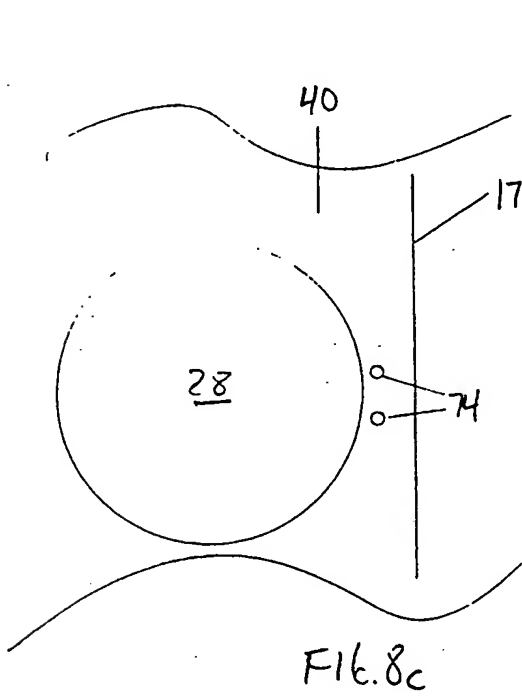
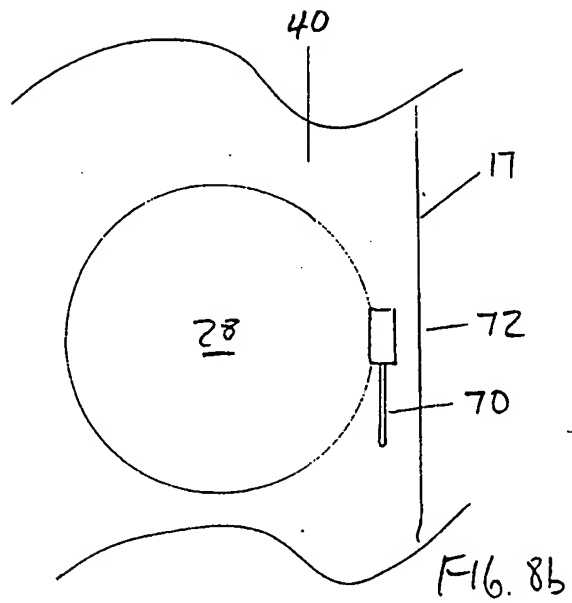
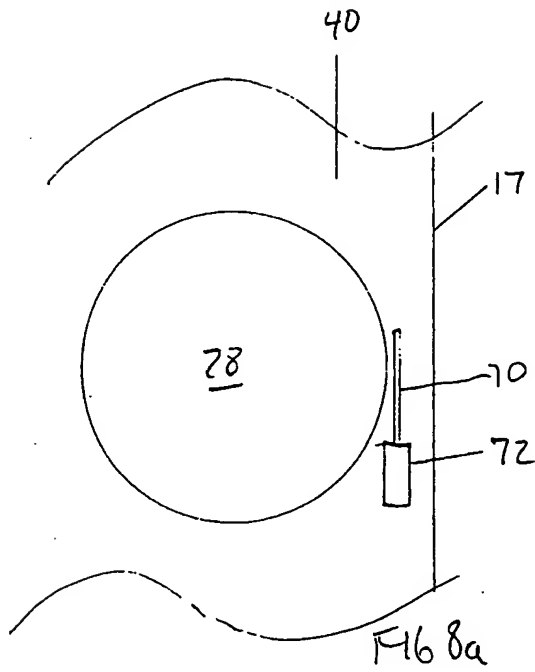
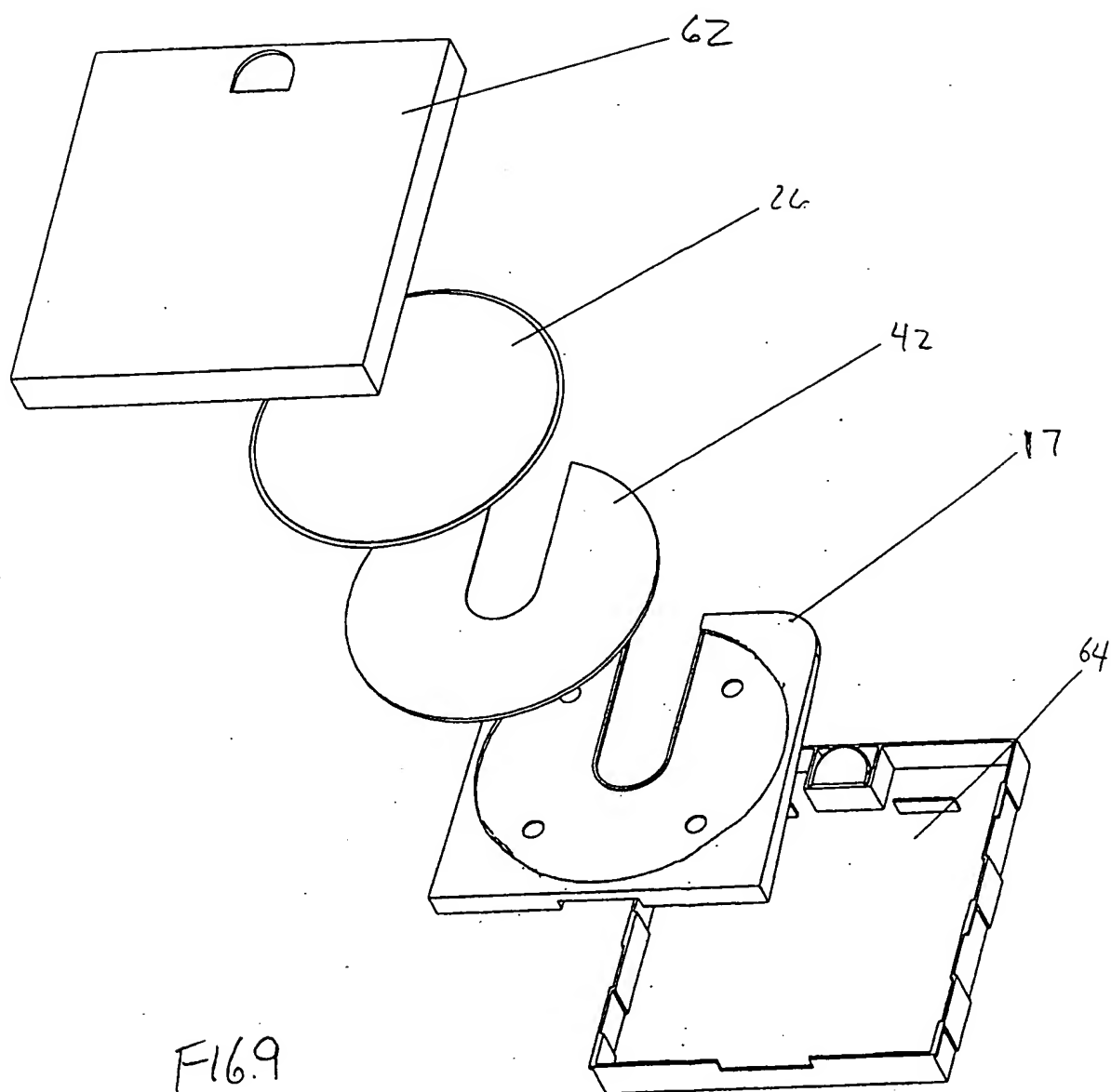


FIG. 5









F16.9

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US00/18398

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(7) :A47G 19/08; B65D 5/00, 85/48, 85/00, 85/30, 85/02

US CL :Please See Extra Sheet.

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 206/454, 449, 711, 710, 303, 308.1, 313; 211/41.12, 41.17, 41.17; 229/103.2

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y	US 3,864,755 A ( <i>HARGIS</i> ) 04 February 1975, See col. 2, line 43-67 and col. 1-26.	1-2 ----- 6-12, 16-22
X -- Y	US 4,977,475 A ( <i>SHIBA et al.</i> ) 11 December 1990, See col. 2, lines 60-69 and col. 3, lines 1-12.	1-2 ----- 7-12 and 17-22
Y	US 5,881,871 A ( <i>IKEBE et al.</i> ) 16 March 1999, See col. 3, lines 37-44.	7 and 17
Y	US 5,819,927 A ( <i>YEH</i> ) 13 October 1998, See abstract.	8-12 and 16-22

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of the actual completion of the international search

23 AUGUST 2000

Date of mailing of the international search report

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**INTERNATIONAL SEARCH REPORT**

International application No.  
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**A. CLASSIFICATION OF SUBJECT MATTER:**  
US CL :

206/454, 449, 711, 710, 303, 308.1, 313; 211/41.12, 41.17, 41.17; 229/103.2